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Senate Commerce, Science and Transportation Committee Holds Hearing on Tsunami Preparedness
LIST OF SPEAKERS

STEVENS:
Well, welcome to our first hearing.
We're honored to have Senate Majority Leader Bill Frist and, soon, Senator Mary Landrieu here to testify on their recent trip to the countries impacted by the Indian Ocean tsunami. And we do thank them for their willingness to come.
In 1994, Senator Inouye and I, along with Senator Hatfield of Oregon, directed NOAA to develop the National Tsunami Hazard Mitigation Program. We had had a tsunami in 1968 after the earthquake, but this was in response to a small tsunami that impacted the West Coast.
It reflected the concern we all shared about the frequency of tsunamis in the Pacific. This bill is intended to build on the current tsunami warning network that we have in the Pacific.
And I do thank the witnesses for being here today.
Let me yield to Senator Inouye, our co-chairman.

INOUYE:
I'd like to join our chairman in welcoming our distinguished panel of witnesses, especially the leader, as they testify on a catastrophe that has left the world in shock and governments scrambling to react.
And we all saw the devastation, the incredible human suffering and the obliteration of entire communities. The destruction hit everyone and everything in its path without regard to national or ethnic identity, the level of economic development or technological sophistication.
Our response as a global community must similarly cut across superficial distinctions among nations and people. Our response, however, must not be a disorderly surge of activity and investment dictated by emotions.
Mr. Chairman, may I request that the rest of my statement be made part of the record?

STEVENS:
Thank you very much.
Unless there's objection, we'll have senators make their statements after the leader and Senator Landrieu make their statements.
Welcome, Dr. Frist. We welcome your statement.

FRIST:
Thank you, Mr. Chairman and Senator Inouye, members of the committee.

It is a real honor for the two of us to present to you, to share our findings on a trip that we made very early to the tsunami region and had a wonderful opportunity to see the very best of compassion and caring expressed and, at the same time, witness the devastation and destruction and the sorrow and the pain that we all know characterized this tsunami.

Thanks for holding this hearing, as we look at ways to prevent as well as to respond to such disasters, such as the tsunami -- a very important hearing.

Senator Landrieu and I, pretty much on the spur of the moment, did leave the United States to witness this destruction, predominately in the Sri Lanka region.

As mentioned, 150,000 people at least have died, over 5 million homes destroyed. Thousands remain missing -- a real focus on children, as will be reflected in both of our comments.

Many of the nation's responders came to help, but I'll have to say right up front, it gives us a great deal of pride to watch our Marines very early on, as part of the 12,000 to 15,000 military personnel who responded quickly with usable forces. It was very impressive to see them coming, moving debris, working with USAID, working in a very cohesive fashion.

The destruction is exactly as described.

I have a slide up. It's a little bit shaded because it's taken through the picture of an airplane. But the coast is there. You can see for several hundred meters, there's total destruction.

What was amazing, as you flew in a helicopter, there's no end to it. It goes for mile -- 10 miles, 20 miles, 50 miles, 100 miles, 1,000 miles.

Much remains to be done. There has been much done already. We have the psychological trauma that is going to take years to deal with. We have shelter that will take years to deal with. The immediate recovery and response, indeed, was quite impressive.

Amidst all the tragedy, what was clear to me is that, in terms of the response, it was not the absence of food, because food was provided fairly quickly, and not the absence of hospitals -- although they were overcrowded -- but it was this whole risk of access to something as basic as water that sits before me and that we all take for granted.

What happened with the tsunami, the wells that people had were filled with salt water, which is not potable water. You had water buckets that were washed away totally. Therefore people, however they got their water initially, were not able to do that.

We had a focus on water. I have a slide up right now that just shows the aide that's delivered. It really typifies everybody coming together, with USAID written on the side of that package; you see Sri Lankan physicians from the Sri Lankan Red Cross there. Aide delivered from around the country in the background there. The types of quarters in refugee camps -- schools that were taken over to house many people.

Quick action was taken, and therefore we didn't see epidemics of malaria or pooling of water that might have resulted. Dredging took place. So as water came in and washed in, early dredging prevented those pools of water from which malaria could have arisen, from typhoid fever could have arisen -- a breeding ground for mosquitoes.

Now we need to look at long-term solutions, which is part of what this hearing is today.

One area that I want to focus on is this area of public health, particularly as it does relate to water.

The conditions that we witnessed in the tsunami's aftermath are common conditions around the world. There are about 1.2 billion people who don't have access to potable water today. That will result probably in about 135 million deaths over the next 15 to 20 years in this country, all because of this lack of access to clean water.

Three proposals that I'd like to mention:

First, clean water should be, ought to be a major priority in our development programs -- the U.S. development programs. And they're not today. We spend about 3 percent of our international development and humanitarian assistance budget on water. That's only about $600 million of $20 billion.

We must work to improve the water quality, not only in the areas that where tsunami-damaged, but indeed throughout the world.

I mentioned 1.2 billion people today don't have access to clean water. 2.4 billion people don't have access to basic sanitation. It applies to children specifically, because there are 4 billion cases -- dire, real cases a year -- and that results in 1.8 million deaths of children under the age of 5 each and every year -- something that absolutely can be prevented.

I show this slide because what is in my hand are these little packets that we had the opportunity to deliver. This little packet, which cost about 7 cents to make, we had put in any kind of water, addresses both bacteria and parasites. And this little packet -- again, 7 cents to make -- will give about 45 days of clean water, which is pretty amazing.

This shows that there are inexpensive solutions that we need to be both mobilized up to develop, which we have -- this is just one of about four types of packets like this -- but also to be able to distribute very, very quickly. And that was one of the things that Senator Landrieu and I had the opportunity to do.

Number two, we, I believe, need to use medical assistance and public health as a currency for peace, as we engage others around the world. And we've missed it in the past, but I believe medicine and public health can be used as a vital tool for international diplomacy, as we look ahead and decide how to spend our resources.

The assistance that we give other nations has its greatest impact when it is on the ground, when it touches individuals in very intimate and in very personal ways at the community level.

I throw this slide in here because this is a hospital that we visited, and this is one of the victims from the tsunami who had come in. But you see the Sri Lankan physicians in the past -- we met Scandinavian physicians come in -- and they make a difference, directly impact peoples lives, both the expertise, but also the reaching out and touching people in a very intimate way.

And we miss it. We don't have any national or international programs now that focus on what I will come back to and that is a global health corps. I do intend to promote a new version of the type of Peace Corps, that we reach out very directly as a global health corps.

It would bring together medical professionals. It would bring together people in this country who want to donate a period of time -- it might be a month, it might be six months, it might be a year -- in terms of technology and expertise and public health and medicine.

And it also would allow them to come back to this country and help educate us and the American people. When you look at the big, big killers that are out there today, it is still

infectious disease. It is HIV/AIDS, it is malaria, it is tuberculosis. So it is a win-win for everyone.

This global health corps I'll be talking more about in the future, but at least wanted to introduce the concept.

So, number one, water should be injected into our development policy and foreign aid.

And, number two, let's must begin to think of using medicine and public health as a currency for peace, part of our diplomacy. And a good way to start that is a global health corps.

Third and last, we should leverage private dollars to develop water infrastructure around the world. We've done it pretty well in the United States of America, but we have not done it elsewhere around the world. We are the nation who can do that.

Private companies, not state entities, will ultimately do the hard work of providing clean, potable water. In the tsunami-ravaged areas, we saw private businesses, big and small, respond in a system, everything from water purification, to packets like this, to logistics.

And what we can do and should do is leverage those private dollars into the field, looking for ways to develop. And the ways we can do it, in certain models, to develop, private-public partnership to inject this capital and help people with their water projects.

In closing, I'll just show this one slide. Yes, this was from our trip, because it was one of the clinics that we visited. And there are two children there because, as Senator Landrieu will say, this tsunami had a huge impact on children.

It reminds me of the medical response. These two kids were sleeping in the same bed because the infrastructure is not fully developed. And as we reinvest in these parts of the world, I hope that we can inject both water infrastructure as well as public health infrastructure.

We have much to do. We've got to be bold. I think this hearing is great start to look both at prevention and appropriate response.

The first steps, indeed, can be quite modest. I do hope that my colleagues will support these proposals in responding with water as a major priority in development assistance; number two, a global health corps; and number three, policy which will leverage private and public dollars to the benefit of kids like this that were sitting with me in the hospital.

Thank you, Mr. Chairman.

LANDRIEU:

Thank you, Mr. Chairman. It is a pleasure for me to join Senator Frist today and give very brief comments, because he's covered so much of what we realized on the trip.

Let me begin just by thanking you, acknowledging a new member of this committee, Senator David Vitter, who I'm sure will be joining us shortly. His willingness to tackle complex problems will no doubt continue the impressive work of Senator John Breaux, who served for many years and most admirably on this committee.

I want to just ditto, if I could, the points made by Senator Frist but add a few new points, if I could.

Jokingly, I told him I'd be happy to accompany him on this trip if he did not require me to go in any operating room, which I am pleased to report, he lived up to his end of the bargain.

FRIST:
But we got close.

LANDRIEU:
But we got close, but I was successful in staying out of the operating room.

But I want to thank you for your introduction of the Tsunami Warning System Bill, which we're here to testify on today, our need to invest in coastal communities, and the immediate and long-term impact of this tragedy on children and families.

First, I would like to say that it's hard to describe the destruction in words, truly, not just the intensity of it, but the expanse of the coastline effected.

In an instant, Mr. Chairman, thousands of people and structures on miles of coastline were simply eliminated, swallowed up, washed away by a massive surge of water.

The only warning that millions of people had was the ominous and awe-inspiring retreat of the ocean's waters, revealing hundreds of feet of sand and beach. Then, in a rush of water, the magnitude of this force wiped out 3,000 miles of shoreline, and carried with it the homes and lives of hundreds of thousands of people.

To give those in our country a better understanding of the magnitude, this chart would be helpful. I've tried to explain this. It would be as if you took an eraser, started at Galveston, Texas, and just erased the coastline all the way up to Bar Harbor, Maine, back as long as a football field, in some instances, or a fourth of a mile to a mile in other instances -- eliminated.

The most amazing thing that we saw was actually the fact that the palm trees survived. I've been through many hurricanes in my life, as many of you all have. And, Mr. Chairman, yourself, you've witnessed a lot of the weather's ferociousness in Alaska. But Senator Frist and I commented, as we flew over this coastline, mile and mile, that the palm trees managed to just bend with the wave and, after the wave receded, came back up. But there were no homes or people or structures underneath the palm trees themselves.

It reminds me to testify this morning that we should think of our coastal communities like palm trees and build them in a way that they can weather these inevitable natural disasters, whether they be tsunamis or hurricanes or the surge of saltwater intrusion.

With adequate and improved warning, better planning and more robust investments in the right kind of infrastructure, our coastal communities here in America and around the world will continue to grow and thrive decade after decade.

Above all these astonishing images, while the death toll was staggering -- it could be over a 150,000, 226,000. It's going to be hard to actually get an accurate estimate. Of course, in many of these countries the census is not as sophisticated as ours. And over 500,000 were injured.

But while the death toll is staggering, it is also extremely disturbing to realize that many of these people could have been saved. Even with minimal time involved, people could have simply walked to safety.

LANDRIEU:
Experts say that oceans may give people as much as five-minute warnings to escape to higher ground. Five minutes could have saved hundreds of thousands of lives.

Mr. Chairman, even the smallest of toddlers and the most frail of seniors can walk the length of a football field, out of the reach of this wave.

So I'm pleased to lend my support and eyewitness accounts to the Tsunami Preparedness Act. This legislation will improve methods of detecting and warning coastal residents about tsunamis, establish important mitigation programs, enhance our research, and assist our friends abroad, as Senator Frist said, and build peace.

But warning, Mr. Chairman, is not enough. We must also invest and reinvest in our natural barriers and constantly review our evacuation routes.

This giant wave not only killed a quarter of a million people, it also, as I said, obliterated the natural coastal barriers in the region. The United Nations Environmental Program estimates the damage to the environment could topple $675 million in loss of natural habitat, an important ecosystem function.

This number should not only concern environmentalists that seek the worthy goal of preserving nature's wonders, it should also concern those whose safety and economic livelihood depend on these barriers being intact.

We know something about that in Louisiana, and so do you in Alaska.

Restoring the reefs and barrier islands and shorelines of these areas will help long-term disaster risk reduction. Without the barriers that act as nature's own line of defense against flooding, storm surges, waves, hurricanes and even tsunamis, human lives are at risk.

Mr. Chairman, as I told you, from Louisiana, I know how vulnerable coastal communities are. 122 million people in America, 53 percent, live in coastal counties or parishes.

The most common threat to these communities is the rapid rise of the water tables, hurricanes, saltwater intrusion.

I'd like to show the next chart briefly and then end with just one or two comments.

In the same area that I showed, the areas in red are basically areas in our southern part of the country that are below sea level. And I'm sorry I did not have the charts for the Pacific and the Atlantic coast. But just the Gulf Coast region will show you, in red, it is 1.5 meters below sea level.

I ask this committee, as we pass this legislation, what have we done if we warn people of danger but don't help them escape it?

In the hurricanes that ravaged Florida and the Gulf Coast region last year, people left their homes only to get stuck in gridlock on highways, trying to escape the 150-, 200-mile-an-hour winds that were projected along the Gulf Coast.

So I ask, as you all look forward not only to this piece of legislation but in the oceans act, or oceans legislation, that is emerging from the recent study, to think carefully about that.

While our work here today will focus on warning, we must also focus on what this disaster means or disasters like this could mean to our own communities in Louisiana.

And finally, one sentence, Mr. Chairman, about the families. Nations are, in fact, built on roads and infrastructure and railroads. But nations are primarily built on families, strong families, united, protective of one another and focused on building and protecting their communities.

Everything we do in this committee or the Foreign Ops Committee or in any other committee in this Congress should be focused on rebuilding these 11 nations family by

family -- picking the one child that was left, uniting them with the one aunt that was left, finding the one grandfather that may still have a fishing boat intact, and trying to put them together to help rebuild these nations -- and in doing so, remind ourselves that building families in America is the best way we can ensure our future.

Thank you, Mr. Chairman.

STEVENS:

Well, thank you both very much.

Leader, last year in the Foreign Operations Appropriations Bill, we put $100 million in there as an add-on to start a program for clean water throughout the world, fashioned after the system that we started in Alaska to deal with the 240-odd villages in Alaska that, until recently, did not have clean water and sewer.

We figure that the cost is about $2,000 a well as we go into places like African villages. It's much less than what it was in our state. But I do believe that we should follow up on your idea, with regard to try and find a way to deal with this access-to-clean-water problem.

I don't know how much of it's within the jurisdiction of this committee, but we're going to take a look and try to work with you on that aspect.

Does anyone have any comment or statement to make to the senators?

We thank you both very much...

FRIST:

Thank you, Mr. Chairman.

LANDRIEU:

Mr. Chairman.

STEVENS:

... and look forward to working with you on this legislation.

FRIST:

And I do appreciate that focus in appropriations, just real quickly, because I think every committee needs to go back and look, because we've had this lack of coordination.

And we absolutely know that that well for $2,000, going back to what Senator Landrieu closed on, has an economic impact, has an impact on the family. It is a huge women's issue throughout Africa. We traveled throughout Mozambique, had a large bipartisan group last year. And indeed, when you talk to women who are walking three to four hours a day each day for water, and then you look at their children, you see the huge economic, social and family impact that a simple well, $2,000, can have on a community.

So thank you for your leadership there.

STEVEN:

Thank you very much.

LANDRIEU:

Thank you.

STEVENS:

Appreciate you both being here.

Our second panel of witnesses are Jack Marburger, the director of the Office of Science and Technology Policy; John Kelly, the deputy undersecretary for commerce for Oceans and Atmosphere; Dr. Arden Bement, director of the National Science Foundation; and Dr. Charles Groat, the director of the U.S. Geological Survey.

We do thank you for being here today, and I want you to take your positions.

I want to state to the members and to the audience that Admiral Lautenbacher sadly is ill, seriously ill, and cannot be with us. We will schedule another time for him to appear. But we do send our best wishes to him.

May we proceed in the way that I presented your names, gentlemen? If you'll make your statements.

Your statements will be printed in full in the record, and we ask you to summarize them as concisely as you are able to do so. It's a highly technical subject, so we do not want to shut you off or limit you unnecessarily.

Mr. Marburger?

MARBURGER:

Thank you, Mr. Chairman and members of the committee. Thank you for inviting me today to discuss the administration's plans for the U.S. tsunami warning system.

I'll keep my oral remarks short. Thank you for including my written testimony in the record.

I, too, have just returned from the tsunami-devastated area, and I, too, was sobered by the extensive damage I saw there.

I attended a ministerial meeting on regional cooperation on tsunami early warning arrangements in Phuket, Thailand. Science ministers from approximately 46 countries were invited, including all the countries affected by the December 26th earthquake and tsunami.

The greatest tragedy of this colossal natural disaster is that many of the deaths, as Senator Frist indicated, could have been prevented if only a warning system had been in place to alert people in harm's way.

Preventing deaths in future similar catastrophes will require a high degree of international cooperation. And I'll mention later steps the administration has taken, and plans to take in the future, for securing international cooperation in developing a global tsunami warning system as part of the Global Earth Observation System of Systems or GEOSS.

Mr. Chairman, about 85 percent of tsunamis worldwide occur in the Pacific Ocean, where life-threatening ones appear about once per decade.

Because of this risk, the U.S. has led in the development of tsunami detection and monitoring technologies and has cooperated since 1968 in the international coordination group for the tsunami warning system in the Pacific, which currently has 26 member countries.

This system operates under the auspices of UNESCO's Intergovernmental Oceanographic Commission, or the IOC. The world's most advanced tsunami detection

systems, NOAA's Deep-Ocean Assessment and Reporting of Tsunami buoys -- they're called DART buoys -- are deployed as part of the U.S. Pacific Tsunami Warning System.

The administration's plan includes enhancing the existing Pacific warning system to provide more comprehensive coverage and faster alerts to broader populations.

Tsunamis occur less frequently in the Atlantic Ocean, Caribbean and the Indian Ocean, but obviously they are still a threat.

Their potential impact is increasing because of the global migration of populations to coastal areas. By 2025, for example, approximately 75 percent of the U.S. population will live in coastal communities.

The current risk, measured by the frequency of occurrence times the consequences, justifies the investment in expanded detection warning and disaster reduction systems.

The administration's plan, which you'll hear more about in other testimony, will expand our detection and warning capabilities to the Atlantic and Caribbean, permitting very effective detection capability in the event of a U.S. coastal tsunami.

Of course, some of the components of a tsunami detection warning and disaster reduction system are unique to the tsunami hazard, such as the sensors for deep ocean detection of tsunami waves, but much of such a system has value for other hazards as well. The communications infrastructure, the emergency evacuation and response plans, damage- assessment tools, public education programs and many other components are relevant in general for disaster preparedness, mitigation and response.

Many federal agencies cooperate to provide technical support for tsunami readiness. Those represented here today -- NOAA, USGS and National Science Foundation -- lead the effort, but agencies like the Department of Homeland Security, with the disaster warning system, and NASA's satellite remote sensing also contribute to tsunami detection and warning, as well as to post-incident damage assessment and response.

Such inner agencies' science and technology activities are coordinated through the National Science and Technology Council, managed by my office, to ensure optimal use of public funds.

U.S. and the international community are well-prepared to create a global tsunami warning system. Catalyzed by the U.S., the Intergovernmental Group on Earth Observations -- yes?

STEVENS:
(OFF-MIKE)

MARBURGER:
No, this is actually an abbreviated version of the whole statement. But I accept, Mr. Chairman. I'd like to thank you for this opportunity.

I'd just indicate that we are cooperating with other nations in an effective organization. We are ready to carry out the intent of the bill that's introduced and administration plans which are consistent with that bill.

STEVENS:
(OFF-MIKE)

KELLY:

Mr. Chairman, thank you for those kind words about my boss. I'll pass them to him, and hopefully that will help speed his recovery. I know he really wanted to be here today to talk about this subject because he keenly cares about it.

STEVENS:

Well, he is a great friend. And we visited with him, when he visited the Hawaii Tsunami Center just recently. So we do send our best wishes.

KELLY:

Chairman Stevens, Senator Inouye, members of the committee, I thank you for the opportunity to testify about NOAA's activities with tsunamis. And I appreciate you submitting my written remarks and including them in the record.

What I'll briefly focus on this morning is the U.S. Tsunami Warning Program, how the U.S. can help the world better prepare for tsunamis, and NOAA's role in the Tsunami Warning Program.

NOAA and its predecessor agencies have provided tsunami warning services to this nation since 1949.

In 1996, as you mentioned, the Nation Tsunami Hazard Mitigation Program was established. And it is a NOAA-led effort to forge partnerships with federal and state entities to protect and, most importantly, prepare for and respond to tsunamis.

Your continued support for that program has helped prepare this nation for the next tsunami in three ways: One, creation of tsunami flooding and inundation maps; the use of these maps to establish tsunami ready committees; and improvements in tsunami warning services through research; better use of seismic and deep ocean tsunami data; and the development of forecast models.

NOAA is proud of the collective accomplishments that both we on the federal side and with our partners in the states have accomplished, and believe your investments and NOAA's efforts have already paid big dividends.

Yet the tragedy in the Indian Ocean shows that we need to do more to accelerate and expand our tsunami preparedness in this country.

The current Tsunami Warning System consists of two warning centers: the Richard H. Hagemayer Center in Hawaii and the West Coast/Alaska Tsunami Warning Center in Palmer, Alaska. These centers are responsible for issuing all tsunami warning, watch, advisory and information messages.

As Dr. Marburger mentioned, NOAA research activities develop the Deep-Ocean Assessment and Reporting of Tsunamis, or DART, buoys to measure tsunamis in the deep ocean and to transmit this information back to the warning centers.

These instruments accurately characterize the size of the tsunami by measuring the pressure wave from the deep ocean floor as it passes. Tsunamis as small as half a centimeter have been measured.

In November of 2003 the DART buoys demonstrated their effectiveness. A large earthquake occurred in the Aleutian Islands and generated a tsunami. The two warning centers evaluated the tsunami based on data from the DART buoy and confirmed only a small wave. This accurate prediction of the nondestructive tsunami is estimated to save the government of Hawaii about $68 million in preparation costs.

We also have about 100 water gauges used by the Tsunami Warning Center to provide information on the magnitude of the tsunami.

The NOAA Hagemayer Warning Center also serves as the operational center for the International Tsunami Warning System of the Pacific, which is compromised of 26 nations. The center's primary responsibility is to issue tsunami warnings in the Pacific basins for tsunamis that may cause damage far away from their source. However, it is the responsibility of the member nation to issue local warnings.

On Sunday the 26th of December, within seven minutes of notification and within 15 minutes of the Indonesian earthquake, both centers issued tsunami information bulletins.

However, an effective tsunami warning system requires many components: one, an assessment of the hazard; two, near-real-time data; three, high-speed data analysis capabilities; four, a high-speed tsunami warning communication system; and last, but probably most important, an effective local communications infrastructure for the timely and effective dissemination of warning and evacuation requirements.

Unfortunately, such a system does not exist in the Indian Ocean.

With global attention on this important matter, we have a great opportunity to better prepare the world for tsunamis through the development of a Global Earth Observation System of Systems.

The United States has been leading this effort for the past two years. Next month in Brussels, 54 nations of the world and the European Union will gather together to reach an agreement that will begin the development of GEOSS.

Vice Admiral Lautenbacher is a co-chair of that effort. And we are going to work to ensure that the GEOSS's first order of priority is to develop a global tsunami warning system.

It is my hope that positive changes in technology, education and cooperation will emerge from what happened in the Indian Ocean.

The Bush administration recently announced that we are committed to completing the current U.S. Tsunami Warning System by mid-2007.

NOAA's contribution to that system includes modernizing and expanding the existing DART buoy network. We plan on installing 32 new operational DART buoys -- 25 in the Pacific, seven in the Atlantic and the Caribbean.

And, as you well know, Mr. Chairman, the weather in the Aleutians is a real challenge, and it complicates our ability to repair the DART buoys when they malfunction. And so, we're going to place in the Aleutian area in the water three back-up buoys. So if a primary one goes down, we'll automatically have an ability to continue to get that data.

We will also procure and install 38 new sea-level monitoring and tide gate stations and expand the operation of the Alaska and Hawaii tsunami warning centers to 24 hours a day, seven days a week. NOAA forecasters will then be better able to protect the United States and will be able to alert communities within minutes of a tsunami- producing effect.

As you mentioned, Mr. Chairman, the Department of Commerce does support Senate bill 50, the Tsunami Preparedness Act, and you do have the letter of support from the department.

In closing, I appreciate your efforts to help better prepare this country for the next tsunami, because it's not a question of if there will be one, it is when it will be and where it will be.

Thank you.

STEVENS:
Thank you very much.
Dr. Bement, the National Science Foundation director, please.

BEMENT:
Thank you, Mr. Chairman, Ranking Member Inouye and members of the committee. Thank you very much for the opportunity to present testimony on the National Science Foundation's role in providing greater...

STEVENS:
(OFF-MIKE)

BEMENT:
Is this better?

STEVENS:
(OFF-MIKE)

BEMENT:
OK. So, again, I thank you for the opportunity to present testimony on the National Science Foundation's role in providing greater understanding and education of tsunami events through science and engineering research.
Because the National Science Foundation has a mission to build the nation's scientific and engineering knowledge capacity and capability, NSF and the communities we support have a responsibility to undertake relevant research in the context of these events.
Through rapid response reconnaissance teams supported by the National Science Foundation, we have moved quickly to focus the U.S. research community's efforts to understand the nature of this event, identify relevant lessons for future disasters, and build on the research that we have funded in the past.
Our rapid response research teams include problem-focused interdisciplinary collaborations. In these collaborations, NSF is working with international partners in countries directly affected or neighboring the disaster to improve communications, collaboration, and priority-setting as the immediate and longer-term research efforts to get under way.
This disaster has raised awareness of and attention to earthquakes and tsunamis and their predictability. NSF has long funded the research and instrumentation aimed at detecting and understanding the impacts of these phenomena. Prominent examples include the real-time Global Seismographic Network, or GSN, the data from which forged the critical core of the early warning of this event.
From the figures accompanying my written testimony, we see the power of this warning system.
Figure one on the easel, with the globe in the center, depicts the location of the GSN stations in relation to the epicenter of the quake, which is in the center of the diagram.

Figure two illustrates the collected seismic measurements from these stations made as the wavefront traveled around the world. These charts illustrate the power of this network, which is operated by the Incorporated Research Institutions for Seismology.

The GSN is funded in partnership by NSF and the United States Geologic Survey. And it is the primary international source of data for earthquake location and also tsunami warning.

NSF also funds research designated to support damage and loss prediction and avoidance. These efforts include the effects of earthquakes and tsunamis on buildings, bridges, and critical infrastructure systems.

Additionally, research efforts center on estimating economic consequences, given the societal impacts and emergency response and warning capabilities.

For example, engineers and scientists at the Earthquake Engineering Research Centers and the Southern California Earthquake Center are working to establish the nature, attenuation, and impacts of subduction-type earthquake ground-shaking.

These centers are developing hazard assessments that can be applied to critical infrastructure design in areas threatened by earthquake and tsunami hazards.

Mr. Chairman, more than 75 million Americans in 39 states live in areas at risk for earthquakes. NSF has recently established the George E. Brown, Jr., Network for Earthquake Engineering Simulation, or NEES, as we refer to it.

This is a major national infrastructure project that is revolutionizing earthquake engineering research. It allows NSF-funded researchers to create physical and computational simulations in order to study how earthquakes and tsunamis affect our critical infrastructure.

The NEES Tsunami Wave Basin at Oregon State University is the world's most comprehensive facility for studying tsunamis and storm waves.

Mr. Chairman, thank you again for the opportunity to testify on a topic of great importance to the science and engineering communities.

I hope that I have conveyed to you the NSF's serious approach to generate new knowledge about the national phenomena that lead to tsunami events, also the design of safer coastal structures, the development of early warning and response systems, and effective steps for disaster recovery.

Thank you very much.

STEVENS:

(OFF-MIKE)

GROAT:

Thank you, Senator Stevens.

Senators Frist and Landrieu gave you a good sense of the dramatic impact that this dramatic event had. Let me give you a sense, in beginning, of the forces of the Earth that caused it.

The December 26, 2004, magnitude-nine earthquake was initiated 20 miles below the sea floor off the western coast of Sumatra. It was the fourth-largest earthquake to strike the planet since 1900 and the largest since a magnitude-9.2 struck your state, Alaska, Senator Stevens, in 1964.

As with other giant earthquakes, this one took place along a subduction zone, where the tectonic plates that make up the Earth's rigid outer layer are thrust beneath one another. This thrusting resulted in a rupture that propagated northward along the plate boundary fault for over 750 miles.

Along the length of that fault, the sea floor was jolted upward as much as 15 feet, lifting trillions of gallons of water into the air and resulting in the forces that provided the tsunami.

While not all tsunamis are caused by earthquakes, most of them are. So therefore, the earthquake monitoring system that Director Bement referred to is critical in providing information about where tsunamis are likely to occur. And so, the network is extremely important, and it has to be up to the task of providing information about the earthquakes in a very sophisticated and a very timely manner.

The GSN that he referred to is the key part on a global scale of doing that. And with 128 globally distributed seismic sensors that are all very modern, we have the infrastructure in place to provide the core part of the knowledge that is necessary to interpret whether earthquakes will generate tsunamis or not if they occur in ocean basins.

A little closer to home, in the United States, the USGS operates an Advanced National Seismic System, which provides seismic data to NOAA's two tsunami warning centers. That system includes a 63-station backbone network that is itself very modern and provides information, supported by 17 regional seismic networks, that ensure that the United States has adequate and detailed coverage for providing this kind of information.

As a result of the Indian Ocean tsunami, the president announced and asked the departments of Commerce and Interior to determine whether our systems were adequate. And as a result of that, the United States Geological Survey has put together a plan to upgrade our seismic system capabilities and our interpretive capabilities, both to provide NOAA with the information it needs as to whether these earthquakes that occur on plate boundaries will generate tsunamis and also to provide information locally to the United States coastal communities as they need it.

So let me close by just indicating what it is we're doing. We're implementing 24-by-7 operations at our National Earthquake Information Center, where the information is gathered and sent out. We're upgrading the hardware and software there to make sure that we have the sophisticated processing that's necessary to give the interpretive information, both on the global sense and in the U.S. sense.

We're also improving the detection response time of the Global Seismographic Network by making data from all stations real-time. In other words, we get the information when it's received by the stations, not with any delays. Only 80 percent of that network is real-time right now.

We're also increasing the maintenance schedules for all of the stations, so that we have data available as continuously as possible.

We're also providing some new software that was generated by the California Integrated Seismic Network, which is a USGS university and state partnership, to speed USGS-generated earthquake information directly to local emergency managers. And this is extremely important in coastal communities, because earthquakes that generate tsunamis close to shore have to be responded to very quickly. There isn't the time nor the instrumentation between those and the shore to provide the warnings. So the earthquake

is a key part of what coast communities need to have in which to base their warning systems. So we're upgrading our ability to do that.

And finally, we're also increasing the geologic studies that occur around the margins of the United States and in the Caribbean to understand the past frequency of tsunamis, which give us some sense of when and where they occur and the magnitude of those.

The Sumatra earthquake, which contributed significantly to the loss of lives and property, also continues us to forward our comprehensive concern about earthquakes themselves. Because they do occur more frequently, and they do destroy lives and property on a more regular basis and in a very destructive basis.

And through the National Earthquake Hazards Reduction Program, in which we partner with the National Science Foundation, with NIST and with FEMA, we will also work with other agencies and universities to improve tsunami hazard assessments and warnings, and to expand our knowledge of tsunami generation and the impacts, and to evaluate the research and operational requirements for effective hazards planning, warning and response systems.

Thank you, Mr. Chairman.

STEVENS:

We just created a new subcommittee on disaster prediction and prevention. We hope that that subcommittee will keep your two agencies pretty busy, because we think we have to find some way to make this a more robust system.

Let me ask you, Dr. Marburger, what's the time line for the administration's improved tsunami detection and warning system? Can you tell us the time line? How soon are you going to move into it?

As I understand it, we're going to finish the one we've already got going, but there's a tremendous expansion of it. How long is it going to take us to do that?

MARBURGER:

That's correct. The agencies indicate to us that they ought to be able to have substantial improvement of the existing system within two years -- at the end of two years, if I'm not mistaken.

Fortunately, all the technology is available, the systems are up and running. And its improvements and improved maintenance and additional deployment of things like these new buoys that's required.

So it should be doable in a relatively short time, Mid-'07 are the dates that I've heard, and they can be confirmed by others.

STEVENS:

As I understand it, Jim Kelly, several of these buoys are not working right now. The DART is on the surface of the ocean; they're connected to a detector at the bottom. Tell us, what is leading to the malfunction of these warning devices now?

KELLY:

Many things.

STEVENS:

I can't hear you, I'm sorry.

KELLY:
Many things.
And you're correct, there are six DART buoys sited in the water today. Three of the six are not operational. One has not been operational since October of 2003.
There are two complicating factors: One is the weather, the weather in the Aleutians. There's a narrow window when we can get boats in there or ships in there to repair them. And then, two, a number of components have failed -- different components have failed at different times. And so, part of our plan is, in fact, to put a better buoy in place of the existing ones and then expand the network.

STEVENS:
Could you put that chart up again showing where these new buoys are going to be...

KELLY:
Yes, sir.

STEVENS:
... and where the existing ones are?
As I understand it, half of the buoys we've deployed right now are not functioning?

KELLY:
That is correct.

STEVENS:
Which ones?

KELLY:
The red ones.

STEVENS:
Tell us for the record.

KELLY:
Three along the Aleutians.

STEVENS:
The three along the Aleutian Chain.

KELLY:
Yes. Yes, sir.

STEVENS:
And what's the plan for replacing those?

KELLY:
Within the last several weeks, or last month, we attempted to repair one. Got it in the water, and then a component malfunctioned.

And we are ready now, as soon we get a break in the weather -- we have forward-deployed the parts into Alaska. As soon as we get a break in the weather -- and we need about seven days of good weather -- we'll get a ship out there and replace the buoys.

STEVENS:
Whose job is it to maintain and assure that they are functioning?

KELLY:
NOAA's.

STEVENS:
Which part of NOAA?

KELLY:
The National Weather Service.

STEVENS:
Do they have the equipment to do that?

KELLY:
Well, they certainly don't own the ships to do it, and they use the NOAA corps to do that or we contract out. But we have a National Data Buoy Center in Bay St. Louis, which has the capability...

STEVENS:
Where do you have it?

KELLY:
Bay St. Louis, Mississippi. And...

STEVENS:
The center's in Mississippi and all the buoys are in the Pacific?

KELLY:
Well, no, sir, we have other kinds of buoys along the Gulf Coast and along the...

STEVENS:
We're talking about tsunami warning now.

KELLY:

Well, yes, sir, but we're also talking about buoy technology, and they have engineers and they have scientists, and they work closely with the Pacific Marine Environmental Lab.

So our operational and maintenance repair facility is in Bay St. Louis, Mississippi.

STEVENS:

How long have they been down, those three?

KELLY:

One has been down since October of '03. One went down in December of '04. And another went down in August of '04.

STEVENS:

Is there a specific program looking at the reliability of these buoys we're going to deploy?

KELLY:

Yes, sir.

STEVENS:

Who's in charge of that?

KELLY:

We're working jointly with the Pacific Marine Environmental Lab and our experts at the National Data Buoy Center.

STEVENS:

That worries me a great deal if we're going to spend money expanding the system, we're going to put out there the buoys that have been failing. At this rate, it sort of looks to me like the taxpayer may be just financing a facade.

KELLY:

It is not our intent to put a one-for-one replacement of the buoys that are out there as we expand this network. We need to put out buoys that are more robust and survive longer.

And in fact, given the challenges that we've had, and as I mentioned earlier, included in the plan will be three buoys that I will call in-water backups, so in case one does malfunction, we will still have something providing us data.

STEVENS:

Thank you very much.

Dr. Groat, the problem of these earthquakes and prediction and tying them into this system, can you tell us -- we have these buoys deployed, but you're not relying on those buoys for your predictions and detection of earthquakes, are you?

GROAT:

No, sir. We rely on the Global Seismic Network, local networks that are subsidiary to it, to understand the earthquakes and the potential for generating a tsunami. Many earthquakes are very large but don't generate tsunamis, even those that occur in the ocean.

The key is getting that earthquake interpretation to NOAA in a timely fashion, so that if it is likely to generate a tsunami, then they can be prepared to use that information.

STEVENS:

Is there a way to tie together what you've got and the other systems here to make a prediction, telling us if an earthquake occurs at any particular place there will or will not be a tsunami?

We seem to only get tsunamis as reaction to the earthquakes, mainly in the Pacific, right?

GROAT:

Correct.

STEVENS:

So are we tied together -- can we say, if there's an earthquake at such and such a place on the Aleutian Chain, there probably would be a tsunami that would go any particular direction?

GROAT:

With the upgrades that we've talked about in our seismic monitoring system and the data processing, we will do a better job of predicting whether the earthquake was of a type that would generate a tsunami. There are many large displacements that go this way, and they don't generate anything.

STEVENS:

OK, but if you can predict there's going to be a tsunami, can you predict where it's going to go?

GROAT:

Well, they go -- it's sort of like dropping a rock in a pond; the waves go in all directions. So once we know where it is, then we can watch where the waves will go, and we can predict that pretty well.

STEVENS:

Thank you. That's what I was in inquiring.

I watched the Discovery Channel the other night. You all did a very good job on that.

(LAUGHTER)

And I did not know that until then. But it is like dropping a stone in a pond. There will be tsunamis everywhere if it's located, say, around Senator Inouye's country. It's possible it could affect the whole Pacific, right?

GROAT:

Very much so.

STEVENS:
Senator Inouye?

INOUYE:
Like most of my colleagues, I'm concerned about the six DART buoys. Three have been out of commission for about 15 months. And if it weren't for the tragedy of biblical proportions, the likelihood is that this Congress would not have been notified. Am I correct?

MARBURGER:
Yes, sir.

INOUYE:
We would not have known that three were out of commission.

MARBURGER:
You're correct. But I would point out that the DART buoys, while important, are not the only components in the network.

INOUYE:
I realize that there are many circumstances that would cause problems, such as weather and the budget. Why was it impossible for NOAA to notify the Congress that three of the six on the Aleutian were out of business?

MARBURGER:
Senator, within NOAA there are a number of observing systems out there. And as a matter of practice, we routinely don't notify the Congress when a given sensor or series of sensors goes out.

INOUYE:
You don't know whether the system is working or not?

MARBURGER:
No, we know, but we don't routinely notify the Congress. We sometimes have problems with satellites, with a given sensor on a satellite, and at least in my experience, we have not routinely provided an update to the Congress of a problem with a satellite sensor. We try to work through it and, in most cases, get it resolved.

STEVENS:
Would the senator yield just there?

INOUYE:
Sure.

STEVENS:

Who do you notify when a buoy goes down?

MARBURGER:

When a buoy goes down, the head of the National Weather Service gets notified, the two tsunami warning center directors get notified. And it is the responsibility of the head of the National Weather Service to get those buoys repaired.

INOUYE:

These buoys are obviously very important. They not only prevent the loss of lives, they prevent the unnecessary expenditure of funds.

I'm just thinking to myself, if that disaster that we experienced in Indonesia and Sri Lanka had occurred in Washington or Oregon or Alaska, and we weren't warned because the three buoys were not operational, the atmosphere in this room would be, I think, much more heated.

MARBURGER:

I agree with you, Senator Inouye, but I believe that, while the three buoys are important, we still have a capability to warn. And even if that earthquake had occurred somewhere in the Pacific, warnings would have gone out. Because even with the three buoys being down, the Pacific Tsunami Warning Center did issue what we call an information advisory that a tsunami had, in fact, been generated.

So while the three are down -- and that's regrettable, and we're working to get them repaired -- we are not totally defenseless because those three are down. And I'm not trying to condone the fact that they are down or they've been down as long as they have. But I think it is important that we don't leave here thinking that we are totally defenseless in providing information and warnings.

And you are correct that one of the great benefits of those DART buoys are it gives confirmation as to the characterization and the magnitude of the tsunami and, in fact, helps reduce the number of what we call false alarms and then saves the local government's money in terms of responding.

And, frankly, most importantly, a whole string of false-alarm tsunami warnings will cause the citizens not to pay attention to it, and that is a critical thing we need to work against.

INOUYE:

By indicating your position, you're not suggesting we don't need any more DART buoys?

MARBURGER:

No, sir, I am not indicating we don't any more DART buoys. They will improve the system. I'm trying to get the message across that we are not totally defenseless with the existing systems. And the citizens of Hawaii and the citizens of Alaska and the West Coast of the United States ought not to get unduly alarmed.

INOUYE:

I have just one more question to any one of you.

Within 24 hours after the disaster in Southeast Asia, major stations, such as CNN and all the networks, began criticizing and suggesting that they should have been notified so they could have used their offices and facilities to warn the people.

Is that a valid criticism? Could that have been done?

(UNKNOWN)

Well, certainly it could have been done. I do not know what the protocol is for notifications, but the National Weather Service is notified instantly, and usually their information is shared immediately with the media.

MARBURGER:

Senator Inouye, it is my belief that many of those news organizations did, in fact, get the tsunami bulletin that was sent out from the Hagemayer Warning Center in Hawaii.

I think what they were asking for was some type of protocol being established wherein the watch officer might make a telephone call to them or somehow take an explicit step to get the information to them.

INOUYE:

Is that a valid request?

MARBURGER:

I think we have to do some analysis of it and what we are talking about. Now, let's take the National Hurricane Center. When hurricanes are coming -- there is a large press presence in the hurricane center. Fortunately, with hurricanes we have a bit more time to start alerting the public.

With tsunamis -- and while this earthquake, as Dr. Groat said, was one of the more massive in the century, we had time to watch the tsunami perpetuate across the Pacific. Frequently in Alaska and Hawaii, you only have minutes. And I'm just not sure, given one watch officer on trying to issue bulletins, clarify the bulletins, that there is sufficient time for him to be talking to the press.

There may be other arrangements that can be made with the press for them to get the information differently.

INOUYE:

There was another criticism in that we did notify the countries involved, but the receiving facility was not operational. Is that a valid one?

MARBURGER:

When you're talking about the receiving, you're talking about the receiving system in the in-country?

As I said in my testimony, we have an agreement with 26 countries in the Pacific Rim to provide information to them, and then they have the responsibility of developing their local warnings and distributing them to their country.

No such system exists in the Pacific Ocean, so I'd -- I'm sorry, I mean in the Indian Ocean. And so, there is some truth in that, that the countries were not prepared to deal with it.

As I said in my testimony, tsunami preparedness has a number of variables in it. To my mind, the most important one is, when you get the warning, have you got a way internally to get it out to your citizens, and have you educated them and worked with them so that they know what to do?

Thanks to both of your help with the Tsunami Mitigation Program legislation in '96, we've been able to do a fair amount of that work on the West Coast and in Hawaii.

INOUYE:

Thank you very much.

Thank you, Mr. Chairman.

STEVENS:

Gentlemen, if necessary, Senator Inouye and I will send you a letter to each of your agencies for this request. We would ask that you report back to us in two weeks what it would take to establish a system to notify the entities who have been mentioned, specifically 911, the Weather Channel; the emergency disaster systems that exist in the 50 states.

We're concerned primarily with this country because of our committee's jurisdiction. I'm sure others will be asking the question about the international aspects of the system to come.

But right now we thought we had a system, and we found, when this occurred, that half of it was dormant, was not working. And we think we ought to have a system that not only we're notified if something's gone wrong, but we also have an adequate apparatus to detect the problem and get at it now.

And beyond that, though, I think that the news media have a legitimate cause to object. There's no reason why we can't have interconnection with 911 or with the Weather Channel or with the disaster system or with FEMA.

We also handle communications, gentlemen, and that can be done automatically. Once you press the button, it can be very ubiquitous and go throughout the country, if it's set up right. So we'd like to know, what will it take to do that? And if you need money, the appropriations bills are coming up; we'll see to it you get it.

MARBURGER:

Mr. Chairman, I may have misunderstood your question. I thought, when you were talking about the press, you were talking about internationally. We and NOAA work very, very closely with the Weather Channel. We work very, very closely with FEMA.

We will provide the information you requested.

I will be surprised, in fact, if those organizations you talked about did not have information about this tsunami. The fact was, though, that the tsunami was not going to impact the United States, and therefore, some of their interests may not have been as great on it.

But internationally, dealing with the international press, I'm not sure what the arrangements are.

STEVENS:

Well, of course we're talking here about one that might be coming our way, and those buoys were supposed to tell us that.

MARBURGER:
That's what I'm telling you. I believe a system is in place if this one would have affected the United States.

STEVENS:
I'm sorry to take your time. Senator Nelson?

BILL NELSON (?):
Thank you, Mr. Chairman.

And thank you, gentlemen, for helping us understand what is involved in detecting tsunamis and communicating the information.

As it relates to a globalization for a warning system, so that we're not only capable of communicating the information to affected locations, what would be involved in making sure that the receiving end of the information is capable of not only receiving but acting on this information?

If the information goes out and there's no reaction to it, obviously then it's not terribly helpful. We will have fulfilled our responsibility, but we're certainly not going to get the result we're looking for.

And if $350 million of aid is going from the United States, given the fact that there's also private aid that will go, what would be involved in making sure that we have receivers at the other end so that there could be action taken on it? And also, what barriers might we encounter?

And some idea of the cost? I suspect that if we're looking at this in terms of dollars and cents, there may be a way to quantify it. There is no way to quantify or qualify the untold misery and loss of life and the disruption to entire areas around the world.

Dr. Marburger?

MARBURGER:
Yes, let me take a crack at that.

First, the most important part of the receiving nation's capability must be communications and education systems country by country in the effected countries.

And it is necessary for some of those countries in the Indian Ocean periphery to build from scratch. There's a great deal of unevenness in the state of development in those countries, as you well know.

The most capable countries are already on their way toward building systems like ours in their countries.

BILL NELSON (?):
Were they in the process of doing that before this, or is this subsequent to the event?

MARBURGER:
I believe that some of those countries were. Countries like India and Australia and Indonesia, Thailand all have important capabilities.

And as a result of the meeting that I attended last weekend in Thailand, it became clear to me that those countries are likely to be the centers. Just as the U.S. and Japan and some other countries around the Pacific have strong systems, I believe those systems will begin to emerge in the Asian nations around the Indian Ocean.

The U.S. will participate in advising and helping those nations to develop strong programs, which include more than just the sensing systems. We have a great deal of experience. We work closely with the UNESCO/IOC, and they are on the scene and helping to advise those countries as well.

I believe that aid will be required, and that aid will be delivered through the normal channels. But at this time, I can't make an estimate of how much might be necessary.

BILL NELSON (?):

Could somebody else help us?

Yes?

BEMENT (?):

I think education and preparation is vitally important, especially in being able to do risk and vulnerability assessment. It's critically important that there be lifelines that are robust and can function under this type of a disaster.

And I think our field surveys will inform that process. We're discovering that there are many bridges that were not pinned to their support structure that were washed away. That affected not only food and water supply, but also medical evacuation.

There are many structures on the coastal regions that were not built to earthquake codes. We're still sorting out what was earthquake-related and what was tsunami-related. Unfortunately they both reinforced one another.

But detection is one thing. Casting that detection into a suitable warning system, based on risk and vulnerability assessment that's done before the fact, so you can at least have an understanding of how much damage can be done and what prior preparation would help mitigate the event, I think is critical in this particular instance.

BILL NELSON (?):

Our ability to detect without the capability to follow up is inadequate, in order for these countries to be able to respond, even though we may.

And I suspect that those three buoys will be corrected rather quickly in the Alaskan area since...

BEMENT (?):

I think Dr. Marburger and his...

BILL NELSON (?):

... there is interest in doing that, yes.

BEMENT (?):

Dr. Marburger, in his written testimony, I think, spelled out all the elements that are needed for a robust system. And it involves not only detection and warning, it requires a

good response plan, a good recovery plan. And it also requires an infrastructure that has lifelines that will survive the event.

GROAT:
Senator, could I...

BILL NELSON (?):
So...

GROAT:
Oh, excuse me.

BILL NELSON (?):
Sure, yes, Dr. Groat?

GROAT:
Just one particular challenging aspect of this, not only internationally but domestically, that we all have to worry about is the fact that if the rock drops in the pond and the waves come from some great distance, we have plenty of time, literally hours in some cases. And if there is a structure in place to get warnings to citizens, news media, whatever it happens to be, we're in decent shape, particularly in the United States.

The challenge comes if this subduction-zone-caused earthquake- generated tsunami is just a few miles off a coast, as it was in the case of Sumatra, where we have very little time. Then the challenge of getting that information, that it is likely to have generated a tsunami, into the hands of the response agencies, even when they're sophisticated, as they generally are in the United States, and then eliciting the proper response from the citizens is a super challenge for all of us.

And that's where these communication links and education links and programs such as the program that NOAA supports are so important. And the engagement of local governments and regional governments and all of the preparedness agencies is so critical.

So literally, you have little time other than to say, "There's a likely tsunami. The tide gauges and others indicate that it may be coming." The "run for your life" business has to be communicated very quickly and very effectively.

And that's a challenge even in our country, where we could probably do it pretty well. But in the countries that we were just talking about, it's a whole other order of magnitude to do that.

BILL NELSON (?):
Is it possible for us to improve from pretty well to very well?

GROAT:
I think we can. I think the subcommittee you described as having created is going to create a much broader awareness of the array of natural hazards that we have. Tsunamis are certainly one, but earthquakes, landslides, hurricanes, all of those things that affect populations very quickly need to be paid attention to, not only from how they occur, when they occur, warning systems, but creating that education process that puts our

populations at risk at less risk. And I think this subcommittee can go a long way in helping that happen.

BILL NELSON (?):
Thank you.
And thank you, Mr. Chairman.

STEVENS:
If the information we're getting from some people about global climate change is correct, we may be in for a lot more of these than we anticipate right now. So I think it's essential that we take this action, and that's why we created that subcommittee.
Senator Smith?

SMITH:
Thank you, Mr. Chairman. I wonder if I can ask that my longer opening statement be included in the record.

STEVENS:
Sure, it will be.

SMITH:
Gentlemen, thank you for being here and for considering our implications of S. 50, which is the subject of this hearing.
As a senator from a coastal state, I'm very mindful that 85 percent of tsunamis occur in the Pacific. I'm also mindful that Oregon is right in the middle of a Cascadia subduction zone.
Apparently, according to your written testimony, Dr. Groat, about every few hundred years, there's a major shift in this zone. And the last time it shifted was in 1700, and that that produced a tsunami on the Oregon coast the equivalent of what occurred in Southeast Asia.
And I understand you're saying that there is a 10 to 15 percent chance that that will occur in the next 50 years.

GROAT:
That's correct.

SMITH:
I guess, on the basis of that, that we're at the end of the likely millennial period where we could suffer another, I'm wondering if S. 50 and the changes that are proposed in that bill are sufficient to give Oregonians, Washingtonians, Californians and Alaskans the warning time that they would need to avoid the kind of devastation we saw in Southeast Asia.
I say that because I understand that this plate is close enough to the coast of Oregon that it would only give coastal residents somewhere between 10 to 30 minutes to retreat.
Are the systems in place to save their lives?

GROAT:

Let me first comment, Senator, from the role that the USGS plays in this, and that is that if the upgrades that we're talking about in the seismic systems and the ability to interpret the information that would occur from an earthquake in the zone you just described were processed and communicated in the way, I think, in the technical sense, the bill does recognize the role that we would play in providing that information to the appropriate places and to the appropriate agencies.

I would have to rely on others to comment as to whether, once that got communicated, whether there was a system in place that would in fact warn Oregonians quickly enough to respond in the way that I just described.

SMITH:

I'm mindful, having come from my state legislature, that we have done a great deal of work on this issue. But I wonder if you're aware, are other states on the Pacific Coast, are they making sufficient preparations for warning systems?

KELLY:

Senator, let me address it from the National Weather Service point of view.

Within the National Weather Service we have a program called TsunamiReady. It is not a very complicated program. You ask the coastal community to have some point where the warning information could come. You ask that that be manned 24 hours a day, seven days a week. You ask if they have developed a communications system to get that warning out to the citizens in that community, and that they have thought through where we would evacuate the citizens to, in event that warning came. And they have some scheme or practice schedule to practice evacuations.

And if they have that, we in the Weather Service designate them at tsunami-ready. They get a number of big placards that go on the state highways and the roadways coming in. There's little notes at the bottom of them, which says things like, "If you feel the ground shake, get away from the waterfront."

That's applicable in your state of Oregon. We work in the state of Washington. It's in the state of Hawaii. It's in the state of Alaska. The local forecast offices up and down the West Coast work with the local emergency managers.

I would love to tell you that 99 percent of the local communities are enrolled in that TsunamiReady program, but I would be misleading you. I think up and down the West Coast there may be a combination of 15 cities/counties that are in the program.

So what we need to do is redouble our efforts to start working with the local areas. Because in the final analysis, the local communities have to be where the action will take to get the citizens ready to move out of the way of this event.

SMITH:

Are you gentlemen, in your positions, are you familiar with the Hinsdale Wave Research Center at Oregon State University?

BEMENT:

Well, the National Science Foundation supports that, Senator, so we're very familiar with it.

SMITH:
I had the privilege of touring that with Dr. Cox, who will be on the next panel. I hope you make good use of it. It is a spectacular facility that certainly taught me a lot about tsunamis long before this one occurred in Southeast Asia. And it's a remarkable asset that we have to spread information about what we're facing if you live on the coast.

And I'm wondering about the inundation mapping. Can that help ensure that coastal residents immediately know when to go and what to do? How...

BEMENT:
I think that's part of the prevention and education. Some of our reconnaissance teams now are trying to infer wave heights based on waterlines and inundation surveys that they're currently doing. Because one of the weak points in our predictive models are the run-up part of the event, where it hits the shore. And in closed bays, estuaries, the beach gradient can have a big effect on how large that wave will be when it hits. And those are areas where we need to refine our current models.

SMITH:
Not only refining the models, but my question is, because of what happened in Asia, do you have sufficient funding to complete these inundation mappings? Because I think, if not, then we need to get you the money, because people need to know where they can go in their geography to avoid the wave.

BEMENT:
Well, we do need to respond to that in our future-year budgets.

Currently, we're planning workshops this spring and summer to assimilate and understand the data coming back from the survey teams. And based on those reports, we will be developing longer-range research activities. And we'll probably have to incorporate that in our budget for future years.

SMITH:
I would strongly urge you to do that. Senator Stevens still has a lot of sway on the Appropriations Committee, and I just think if you need funding for inundation...

BEMENT:
Well, I did shift some funding for next fiscal year request to help address some of that, but it may not be adequate.

SMITH:
Anything that you need to make it adequate, on behalf of the people of Oregon, please do it.

BEMENT:
Thank you.

SMITH:
Thanks.

STEVENS:
Senator DeMint?

DEMINT:
Thank you, Mr. Chairman.

I'm from South Carolina, so I'm on the Atlantic side. And I think what you're suggesting, we're not at nearly as much risk? Is that what I understand from the panel? Although there may be some applications that we need on the East Coast.

Just a quick question, I guess to anyone on the panel. I appreciate the information that you've shared. I certainly don't pretend to be anywhere near an expert on what you're talking about after a few minutes.

But based on what you've told me, I have somewhat of a concern that we might be quickly expanding antiquated technology in order to cover our bases as quickly as we can.

The failure rate of these buoys is apparently a concern of everyone who's heard that. And it doesn't sound like a quick fix or a few new parts is going to solve the service problem of these.

And my question is simply, has there been a coordinated attempt to look at all the technology that's available to see if water-based is really the way to go? Are there land-based water-level measurements that could go out several hundred miles that could give, particularly, states like Oregon that expect a very short notice a quicker way to respond than something that's floating around in the ocean that may not be working?

That would be my only question. I think everyone is going to be interested in funding whatever works. But from what I've heard today, I'm a little concerned that what we may be funding might not be the most reliable way to go.

Gentlemen?

KELLY:
Senator, on the observation side, there are two components to it. One, there are the DART buoys. Larger in number are the tide gauges I mentioned. We're going to put some 38 new ones in. There are a number of tide gauges up and down the United States coasts today. They serve multiple purposes, not just for tsunamis.

The utility of the DART buoy is, with it being out in the deep water, you get an earlier confirmation as to whether a tsunami has or has not occurred. On the side that it has not occurred, that prevents the number of false alarms from being too high. On the fact that it did occur, then you can give more positive statements to the citizens that something not very nice is coming their way.

Yes, we have challenges with the DART buoys. We've had trouble maintaining them. I would point out that we know of no other country in the world that has developed a technology like this. The Germans contend they have a system, but the best I can determine, no one has ever gotten any data from the system and been able ever to see it to operate.

So I don't want to minimize the technical accomplishments that the researchers that have developed these DART buoys have made in doing it. And yes, indeed, we do have some reliability problems with them. But when you're dealing with high-tech equipment -- and I'm not trying to minimize that -- that's not an unusual thing.

It is not our intention to, with all the new DART buoys that are going out there, to replicate old technology that has given us maintenance problems. We are going to try to make it more robust.

But we believe the data from the DART buoys is an essential element of the observing network. It is not the only element, as I tried to say earlier. It's regrettable that three of the six are down. We still have some capability. We would like to have more capability.

But we do believe that the DARTs are an important part, and we are going to try to make them more reliable.

DEMINT:

I yield back, Mr. Chairman.

STEVENS:

Thank you very much.

Senator Cantwell?

CANTWELL:

Thank you, Mr. Chairman, and thank you for holding this hearing on the Tsunami Preparedness Act of 2005.

I had an opportunity, in the last 10 days, to visit the Pacific Marine Environmental Laboratory in Seattle that is part of the NOAA operations.

And first and foremost, I want to thank the chairman and the ranking member for their diligence on this issue. The one thing -- when a crisis happens, you go back and look and see how prepared we are to date. And one thing that is very clear to me is that Senator Stevens and Senator Inouye, because of incidents that have happened in their states, have put a lot of energy into focusing on this issue and getting us where we are to date.

I had the chance to see the current DART buoy and to understand the information system that connects to it and how it relays information. And I also got a chance to see the next-generation buoys, which will be much easier to deploy.

So I have a good sense of where we're heading with the technology, which for taxpayers and security reasons will be much more efficient in deploying, instead of spending hundreds of thousands of dollars on a research vessel, trying to go out hundreds of thousands of miles to deploy this, we might even be able to push them out of an airplane or off of any kind of vessel.

So we're making good progress.

That doesn't mean that we in the Northwest don't want to know when the current buoys are going to be fixed. And I know my colleagues have probably pounded on that point already, so I won't say anything other than we're very concerned and we'd like them to be, obviously, operational as quickly as possible.

The one thing that is clear when you see the technology at the Marine Environmental Laboratory is that this act is really about the preparedness element. It is about mapping. It is, in the sense of what happened in Indonesia, understanding that the effects of such

devastation basically wipe out roads and bridges, and they hinder not just evacuation but also support in the future.

So I guess my question to General Kelly or to Dr. Groat is just, how fast can we get this mapping done that will then show us -- you know, for Puget Sound, I think the last time we had a -- in the year 1700, a 30-foot-high tsunami smashed into our coastline. And there is a geological survey that estimates that there is a 10 to 14 percent chance that another major Cascadia quake could happen in the next 50 years.

So, yes, we're very interested in how soon the mapping could happen. And exactly, then, what does the mapping provide us, in the sense of local law enforcement and others, in this certainty of our preparedness efforts?

(UNKNOWN)

Senator Cantwell, the field data that's coming back will help inform the mapping process. We currently have remote sensors, high-resolution, medium-resolution, low-resolution sensors, that are actually gathering data in real-time of the affected regions in this latest disaster.

Once we assimilate that data, we will be able to accelerate I think the mapping effort. And by learning through our predictive models, we can infer what the damage zones would be if such an earthquake were to happen, for example, at the Cascadia fault line, which is about as large as the fault line in the Indian Ocean, the extent. It's almost a similar event.

As far as time lines are concerned, I am not at the position to really lay that out in any great detail, but I think we're going to be much better informed on how to go about doing that.

GROAT:

If I could comment, Senator Cantwell, you've hit upon a very sensitive point. I think with both U.S. Geological Survey and NOAA, there are several kinds of maps that are useful in this process.

Inundation maps are clearly more important. Accurate maps upon which models can be built are important. But what they depend on, in our case, the topographic maps that show the details of the topography on the on-shore areas, and in the case of NOAA's responsibility the bathymetric maps that are off-shore.

Having the most modern, current information about what the land looks like and what the sea bottom looks like is really critical to providing the information for inundation maps and for providing information to response agencies about surges in areas that might be effected.

I know in our case -- and I can't speak for General Kelly -- getting that information as current as it needs to be -- many of our maps are 27 years old -- so that it reflects the coast as it is today and the infrastructure as it is today is a real challenge for us.

And if we're talking about funding challenges to provide information needed for those efforts, this is one, in our case, where the mapping of the topography needs to be modern, needs to be current, needs to be digital, so that it can go into the models and in the inundation mapping.

And I know General Kelly has similar concerns.

KELLY:
I'll just second what Dr. Groat said. It is a challenge to get current surveys of the undersea and what the shoreline and the sea surface is.

CANTWELL:
So are we talking years?

GROAT:
I think the capabilities are there now, with LIDAR and some of the technologies that provide information about the landscape in digital form, to turn those into digital map products, that we don't have to be talking about very many years in critical coastal areas.

In other words, we're not talking about decade-long programs. I think in a matter of a few years, with the funding, we could have current, updated, digital information about the areas of the coast that are likely to be impacted by this sort of event.

BEMENT:
I can say that if you look at just the area of the terrain that's above the water level, the inland terrain, there are geodetic surveys that are currently under way, some involving Cal Tech. Other universities are involved. And that's part of the survey work that's currently going on at the present time.

Now, how all that geodetic information will be factored back into topological maps and update the maps, that's outside the science area. That's more in the...

GROAT:
We do have a framework for that called The National Map, and it's an attempt to bring information from the sources that Dr. Bement described and others, who are gathering digital information about the landscape, into one framework, so that it is the same around the coast, so we have a product that has set standards, set approaches to providing this information that everyone can use in a standardized fashion.

So we do have the framework. We do have a lot of organizations gathering it. What we don't have is sufficient support to gather that information as quickly as we would like to have it.

CANTWELL:
Well, I think that was the point I was trying to draw out. It's just that it's not a next-week project, but it isn't also a 10-year project.

GROAT:
Exactly.

CANTWELL:
And the sooner that we can get about the mapping, the better plans for preparedness that we could do.

I see my time is almost up, Mr. Chairman, but if I could just ask another question about inland water waves, I think a lot of people think of this as the coastal regions, but Puget

Sound, with its population base cities of Seattle and Tacoma and up the coast line of Puget Sound, Bellingham and others, are as susceptible to activities.

How do you see the mapping benefits of that helping to prepare large communities with not just populations that have to be evacuated but infrastructure?

(UNKNOWN)

I think the mapping, as you're pointing out very accurately, needs to extend into those inland bodies, those sounds, those estuaries, those bays that are accessible to the sea where waves can come in, as they have in all cases with these tsunamis. If there's an inlet, they'll come through them.

And that the infrastructure, as well as the people in there, needs to be accurately represented on these maps. And that's part of The National Map, is to include not just the terrain but the infrastructure that's there -- houses, buildings, bridges, so forth.

And that needs to be as much in place for areas on these inland bodies connected to the sea as it is on the raw coast. And that is part of the structure that we're talking about.

CANTWELL:

And if I could just throw this in, if we had this mapping done before and we knew what was going to happen in Indonesia -- which, in fact, I know people, the minute the earthquake happened, ran to the lab at the Pacific Laboratory in Seattle and started trying to do modeling, but by the time they got information the tsunami was actually hitting.

But say we had got all this mapping done three or five years ago, what would we have done differently in preparing that community?

(UNKNOWN)

Let me say, the main problem in the Indian Ocean countries was not technical warning. The main problem was the absence of local public education and local communications systems. That was the biggest thing that was there.

There were warnings available, based on seismic data alone, that were transmitted to some spots in the Indian Ocean that could receive them and knew what to do. But the biggest challenge that we have is to provide infrastructure in those nations so that they can educate their people and communicate with them when they get the information.

So while simulations and additional instrumentation in the Indian Ocean are important, nevertheless the most important thing is the public education and the identification of the critical infrastructure long before the tsunami hits.

BEMENT (?):

One thing that's going to be a major unknown is what really changed as a result of the tsunami and the earthquakes with regard to the relationship between ground water and surface water and what damage was done to the aquifers that may not be reversible.

Had that information been baselined, we might be able to detect or determine what changes took place. Now, that's one thing we could yet do in our own coastal regions, is to develop that baseline data so that we would be better informed of what possible damage may be done to aquifers and other sources of fresh water.

KELLY (?):

Senator Cantwell, you put your finger on a real challenge. And while the number of deaths pale in comparison to what happened in Indian Ocean, it was a very active hurricane season last year. They were, overall, very well-forecast.

The government of Haiti was provided good forecasts and good information on what was likely to happen with the hurricane, and they still lost 3,000 of their citizens due to flooding. And it's my belief, in large measure, that that's tied to the infrastructure challenge that that particular government faced.

And so, it cuts across all natural disasters, and it is a big challenge.

CANTWELL:

Thank you, Mr. Chairman.

STEVENS:

Thank you, Senator.

Thank you very much, gentlemen.

I'd just drop a little pebble in this small bowl up here. You ever think what would happen if the Madrid fault slipped again? I mean, I heard that bells rang in the churches in Boston and the Mississippi changed its course. I mean, we still have problems all over this country. It's not necessarily coast line.

Secondly, back years ago when the Navy was building up Adak and we finally ended up with about five different naval bases on that little island, we built a tsunami-proof shelter. We didn't build any more because of the cost of that one.

But there are things that we must think about, and that is, can we get a tsunami-proof shelter in areas where they might be needed? I hope that our subcommittee that we're going to create would go into things like that.

And we look forward to working with you, but we're very serious about this coordination thing now. And I hope you will help us by giving us your ideas of what we could do to assure that there would be proper notification to all the public sources that would help disseminate it.

Senator Inouye?

INOUYE:

I just wanted to clarify the record.

In November of 2003, one of the DART buoys issued data and suggested that a massive tsunami was on its way to Hawaii. But thanks to the efficiency of NOAA, they immediately clarified the data and suggested it was not hitting us.

And we've calculated that it saved the state of Hawaii about $70 million. Otherwise we would have spent all that money. So I want to thank you very much.

And, Mr. Chairman, may I submit written questions?

STEVENS:

Yes.

I would appreciate it if you would respond to questions that will be submitted by the individual senators.

And, again, we thank you gentlemen for joining us. We consider this to be a very important first hearing.

We'll now turn to the third panel.

Dr. Roger Hansen, professor at University of Alaska in Fairbanks and the director of the Tsunami Warning and Environmental System for Alaska; secondly, Ms. Eileen Shea, project coordinator of the East- West Center of Honolulu, Hawaii; and thirdly, Dr. Daniel Cox, the director of Hinsdale Wave Research Laboratory at Oregon State University.

Senator Smith has a conflict, so as a matter of courtesy, Dr. Cox, we are going to call on you first.

We do hope that you all will give us a summary of your statements or at least shorten them somewhat. But all of your statements we have printed in the record as so read.

SMITH:

May I thank you for that courtesy and also welcome Dr. Cox. He has taken a red-eye to be here. Senator Cantwell and I know that flight very well.

Welcome.

STEVENS:

Dr. Cox, I welcome you. I left Oregon State College to go to war some 50-odd years ago. Nice to see you here.

COX:

Thank you very much, Mr. Chairman and members of the committee, for this opportunity to discuss the research that we're doing at Oregon State in the Hinsdale Wave Research Laboratory. I'm the director of that laboratory and also associate professor in Civil Engineering.

We are home to the world's largest facility specifically constructed for tsunami research. And I would like to give you, just sort of briefly, the history of it, just to show you that this has been many, many years in the making, planning, long before I got there. I've only been there for about 2 1/2 years.

And I also would like to tell you just sort of how the tsunami community has come together, a little bit about what we're learning about the recent events, and then how we're trying to improve the nation's ability to respond to tsunami disasters, emergency planning and so on.

In the 1990s, there was a series of NSF workshops to decide what are the nation's needs for tsunami research. And as a result of these workshops, there was a proposal to come up with a very large wave basin. This a large, rectangular, concrete basin that can very accurately repeat a tsunami-like wave that's called a soliton.

And the main purpose of this facility is to provide proof that the numerical models are working well.

We've heard a lot of testimony today talking about inundation mapping and the reliance on these maps for telling people where to go, directing them, deciding what kind of infrastructure will be in place after the tsunami event happens and so on.

But all of these computer models have to be tested very carefully before we rely on them. And we use, to some degree, the field work that's been done, trying to piece together the clues from the site reconnaissance surveys. But they don't have enough information. They don't give you the wave height, the wave direction in all locations.

And so, we can very accurately make physical models with very carefully controlled conditions and then compare the results of the physical models with what the numerical models predict to us.

And that's how we use our facility.

We also use it as sort of a center for the research community. It's a great place where people gather and share ideas, exchange information.

We had two of our professors going to Madras, to India, to look at, to survey the damage, and then they'll come back, share their results, hold a series of seminars and so on. So it's also provided a great focal point for the research community.

There was also a report published by the National Research Council for the NEES program. And in that report, it outlines very specifically what are the challenges for the research in our areas, and that includes better understanding of the tsunami inundation that we heard about earlier today. And also, the tsunami impact -- what happens when that wave hits buildings and bridges and other critical lifelines that would be necessary in an evacuation.

The long-term goal is really to develop a comprehensive numerical model that includes not only the hydrodynamics of the wave and the wave impact and the debris flow, but also includes human factors, how people will respond in a crisis. And this will greatly improve our ability to plan for tsunami disasters.

So I'd like to finish here and just say that I think we have an extremely unique tool here for the nation to use. It's a shared-use facility. It's hosted at Oregon State, but it's really designed with a number of researchers in mind. We bring them here, we do -- the research, the tsunami research, is supported by the National Science Foundation. So if their proposals are accepted, then the work is supported in our lab for free or by the National Science Foundation.

And, yes, with that, I'd be happy to answer any questions that you might have.

STEVENS:

Thank you very much.

Senator, do you have any questions? I'd be pleased to yield to you.

SMITH:

Thank you very much, Senator.

Dr. Cox, thank you for being here. I very much enjoyed the tour that you gave me.

Having listened to today's testimony and yours as well, I'm curious as to your thoughts, if you've had a chance to review S. 50 and the administration's proposal from an academic perspective.

Do you see these proposals as adequate, in terms of research, mapping and education? Is this a sufficient step forward?

COX:

I think it's a step in the right direction. And I think the points that are outlined today -- the importance of education -- once you have a warning system and you tell people, you've got to tell them what to do and they have to know how to respond. There's no time to educate them during the time of crisis.

So I think these are all steps in the right direction.

We've talked about inundation mapping. The future of inundation mapping is really trying to start to map the intensity of the event, not just where the last water line is. And the intensity is really related to whether or not a building is going to withstand the attack or not.

So there's, I think, a lot more work that we need to do to better prepare ourselves for the inevitable tsunami.

SMITH:

Thank you, Dr. Cox, for being here and, Mr. Chairman, for your courtesy. I appreciate it.

STEVENS:

Thank you, Senator.

Senator Inouye? Do you wish to hear the other witnesses first?

INOUYE:

Yes.

STEVENS:

May we proceed then, Ms. Shea?

SHEA:

Thank you, Mr. Chairman, Senator Inouye, members of the Committee. It's my honor to be here today, and thank you for the invitation to talk about S. 50, the U.S. Tsunami Preparedness Act, as well as your general interest in building disaster-resilient coastal communities.

I first sat in this hearing room over 30 years ago as a NOAA employee in congressional affairs. And I believe that S. 50 represents just another step in your long legacy in this committee of commitment to the coastal communities, the coastal resources and the coastal businesses of this nation. And, therefore, it is an honor to be here.

I'd actually like to just touch on three things in particular, and they have all come up in one form or another today.

The first is I want to commend the committee for taking a multi- hazard perspective on this bill and on building our resilience to tsunamis and other natural hazards.

The same coastal communities in Southeast Asia and along the United States that are subject to tsunamis are also subject to other natural disasters: coastal flooding, typhoons, hurricanes, high wind and wave events.

All of those events have the potential to threaten life and property, and all of those events are things that we need to address if we're going to build what I like to call an effective risk- management information system.

I believe that S. 50 and much of the discussion of the testimony today is headed in the direction of building that kind of risk- management information system.

But I'd like to pick up on something that, Senator Inouye, you mentioned in your opening remarks, Senator Cantwell has, Senator Nelson has, others have mentioned, the idea of focusing on the receivers of these informations.

It really doesn't matter how accurate and how efficient the arm of a quarterback is if there isn't a person at the other end waiting to receive it and a team of people -- NGOs, the media, the civil society community leaders, the governments at a local level -- a team of people who can help get that individual down the field and in the end zone.

It is essential, if we are to pursue building disasters, resilient coastal communities, that we do focus on those receivers of this information.

An effective warning system, like we've heard discussed by many of the panelists today, is a part of that information system. But we really must invest in that education program.

And TsunamiReady communities is a good example of helping to reach out to communities and prepare them. But it's only part of the picture.

And we've heard several witnesses today, as well as several of the members, talk about the broader education effort -- formal and informal education, technical training, and also leadership training -- building the next generation of leaders of these institutions that will be responsible for warning and response.

The second element, for me, of an effective risk-management system is this concept of a better understanding of vulnerability and our choices for adaptation, our choices for building resilience.

We've heard much talk today about these inundation maps. These are parts of tools for understanding how exposed we are to a risk, how sensitive are we to a risk. The other part of the equation is, how prepared are we to deal with that? How resilient are we? How much like those palm trees that Senator Landrieu mentioned are we, are our businesses, our infrastructures, our key economic sectors and the people in our communities who call the coastal zone home?

Building that partnership, building that understanding of vulnerability and our ability to adapt is an essential part of what we're about.

I think that it's important to remember that building this understanding of vulnerability is not just a matter of funding a few socioeconomic studies. It's about establishing a new way of doing science. It's about participatory research, in which the decision- makers and the community leaders and the scientists and the technical experts work together in a process of shared learning and joint problem-solving.

It's also important to remember that this is probably best done at a regional level. One size does not fit all when it comes to education programs, warnings systems, or adaptation. It's really important, I think, as we consider the next steps, that we consider the regional effect.

And finally, it's important to build critical partnerships. I don't have to add much to the discussion today about the international partnerships involved in the tsunami. But I will mention that, in thinking about those receivers again, that one institution that wasn't mentioned in the tsunami arena is the International Tsunami Information Center in Honolulu, which is the focus of the receiving education, reaching out, education and training, both in the U.S. and abroad.

Finally, I would like to touch on a regional activity. There is in the Pacific now something called the Pacific Risk Management Ohana. "Ohana" means family. "Ohana" means working together.

Three years ago, under the leadership of the NOAA Pacific Services Center, all of the federal agencies in the Pacific Islands region who work in disaster management sat around a table together to talk about better coordinating the work that they do.

As a result of that initial meeting, the scientific institutions active in risk management in the Pacific, the federal agencies active in risk management in the Pacific, and state and local entities and organizations are all now acting together in the context of PRMO -- a coordinated effort on the part of all of those interested institutions to work together.

In one way, it's an example of the kind of coordination that you're calling for in S. 50. In another, it's a reflection of how important it is to do this at the regional level, because it is at the regional level where we can work together, touch each other in ways that the majority leader mentioned today. It's about understanding the people, the resources and the businesses in these communities. And I think we're on our way.

Thank you for the opportunity. I'd be happy to answer any questions.

STEVENS:

Thank you.

Dr. Hansen?

HANSEN:

Thank you, Mr. Chairman and members of the committee, for inviting me today. I'm the state seismologist for Alaska and a research professor at the Geophysical Institute at the University of Alaska Fairbanks.

I've been invited today to give testimony on the tsunami warning system in Alaska.

Today tsunami safety in Alaska comes from a strong partnership between several state and federal agencies as a result of the participation in the National Tsunami Hazard Mitigation Program, which has been aided in Alaska by expanded roles for the University of Alaska, the State Geological Survey, the State Emergency Management Agency, and the West Coast and Alaska Tsunami Warning Center, run by NOAA.

HANSEN:

This program consists of hazard assessment of our coastal communities through its tsunami forecasting, monitoring and warning guidance and education and mitigation at the local levels.

I will speak briefly on each of these topics.

On March 27, 1964, a magnitude-9.2 earthquake ripped through the Prince William Sound in southern Alaska, generating a devastating tsunami. Though the death toll in 1964 is minuscule compared to the Indian Ocean disaster, Alaska today still faces difficult challenges forewarning its at-risk communities of the occurrence of tsunamis.

These challenges come in part from the nature of our remote location; our irregular coastlines with complex bathymetry and topography; the vast size of our state, where our coastlines extend from equivalent distance of California to the tips of Florida; that we live in one of the most seismically active regions of the world; and the lack of infrastructure throughout the area for both operations and maintenance of monitoring systems and for consistent and timely communication of warning messages -- warning guidance.

First and foremost, we must be able to detect events that can trigger tsunamis, and this is done with the use of seismology and seismic networks as the primary method to detect

earthquakes that may cause tsunamis. Sea-level data, both tide gauges and deep-ocean buoys, are also monitored to verify the existence of and the danger posed by tsunamis.

But our primary hazard comes from the local tsunami generated by nearby large earthquakes in or near the coast of Alaska. The deep- ocean buoys, while a part of the larger warning system designed for the Pacific white tsunamis, are secondary indicators for local Alaska warnings. This is because a locally generated tsunami wave will likely hit most of Alaska's coasts long before it reaches the deep- ocean buoys. Therefore, we must rely on the rapid warnings that can be issues from the detection of large earthquakes by a seismic network.

Modern seismic recordings can provide rapid information on earthquake location, size and the distribution of sea-floor deformation that generates tsunamis. However, since much of the seismic network in Alaska has been in operation since the 1960s, many stations are in need of modernizations to achieve this goal.

Over the past few years, the Alaska Earthquake Information Center, the state seismic network operator, was tasked through the National Hazard Program to develop 18 of these modern stations for Alaska and ensure the timely delivery of this data to the warnings centers.

The university program has now increased the number of modern stations that we can provide to augment this sparse improvement and, through applied research efforts, provides some enhanced information on the local earthquakes.

However, even with the funding of both the national program and the university program, nearly 75 percent of Alaska's seismic network still relies on outdated equipment. This leaves vast areas of Alaska, and in particular the very seismically active Aleutian Islands, still underpopulated with modern seismic stations.

Mitigation: It is important to recognize that a tsunami warning system must go beyond just the ability to detect a tsunami and send a warning message. The most important aspect of tsunami warning systems is the existence of a mechanism for disseminating warning information to the people on the shorelines and for the recipient of the warning messages to understand how to react.

Tsunami hazard mitigation requires a long-term, sustained effort of continuing public education and responsible planning decisions in coastal communities. The power of education is clear.

The state of Alaska partners are well aware of our difficulties in reaching our more than 80 communities at risk to Tsunamis. Improving the warning communication and outreach infrastructure at the state and local level for both emergency managers and the public represents the most important improvement to be made in Alaska for saving lives.

Hazard Assessment: Tsunami warning and safety procedures require an understanding of hazards and risks associated with tsunamis. In Alaska, led by researchers at the University of Alaska, Fairbanks, we are evaluating the risk by constructing inundation maps for all the at-risk communities through our super-computer modeling of tsunami water waves from scenario earthquakes and landslides.

Reliable modeling results, however, require that we have accurate bathymetry. And, in fact, we need this bathymetry to a resolution that is not available in Alaska today.

Much of the sea floor along the shallow waters off the coast of Alaska have not been mapped in many years -- some areas not since before the 1964 Prince William Sound

magnitude-9.2 earthquake. And note that large earthquakes can change bathymetry on local areas of the sea floor by tens of meters.

Collection of improved bathymetry along Alaska's coastal communities should be a top priority for enhanced spending of any tsunami program.

In addition, it is important to stabilize the funding necessary to create the numerical models and inundation maps.

In summary, Alaska has in place a partnership to address the threat from tsunamis. Yet we still have continuing needs for improved monitoring with seismic and tide-gauge networks, scientific infrastructure for numerical forecasting of tsunamis, and the civil infrastructure to educate and warn people.

Thank you again, Mr. Chairman and the members of the committee. I am happy to answer any questions you have.

STEVENS:

Thank you very much, Dr. Hansen.

Sorry to be reading. A memo just came up from my office.

I'm told that you just made a little history, Doctor. You just lectured your graduate students at the University of Alaska, who are tuned in and watching this on a live broadcast through our Web cast.

So, thank you for coming here. And your students I'm sure will appreciate the fact that you're here and they're there.

(LAUGHTER)

HANSEN:

They got a free breakfast.

(LAUGHTER)

STEVENS:

I think we ought to thank them. You realize what time they had to get up to watch you.

HANSEN:

Yes.

(LAUGHTER)

STEVENS:

It's four hours earlier than we are.

But anyway, I want to ask you first, Dr. Cox, am I correct in reading your testimony that you think you could test things like buildings?

COX:

Yes, I could.

STEVENS:

Could you test a model of a tsunami survival hut, if we could devise one?

COX:

Yes sir.

STEVENS:
Could you devise one?

COX:
We're working on it. And I think also...

STEVENS:
Are you thinking about something that's big enough for a lot of people or just a little one for individual islands?

COX:
It -- I'm at a loss for words. But what we're looking at is really, can the computer -- let's say, could a numerical simulation correctly predict the impact force on the building, however that building is constructed? And so, what we measure in our laboratory is the actual force of that wave on a building.

And then, let's say if you were to design break-away walls, for example, let's say in a hotel, a modern hotel, if you had two strong walls and two weak walls, at what point would the weak walls break away, for example.

STEVENS:
Well, I'm looking at it a different way. When we did the building in Adak, we looked at what could survive a wave going over it and coming back over it. OK?

COX:
Yes.

STEVENS:
In terms of a lot of people. Can you look at that for the purpose of determining, could we start a program of some sort of fairly inexpensive shelters designed in a fashion that could resist waves at force that you go over it and come back over it?

COX:
Yes, sir. And in addition to the design of one particular building, what we're finding out from the field surveys is that it's often the arrangement of the buildings that can either increase or decrease the forces. So that's something else we'll be testing in the laboratories: How does the arrangement of particular buildings improve our ability to withstand the tsunami?

STEVENS:
Well, we devised wings that were capable of standing up at greater than the speed of sound. So I think you ought to be able to find a way, if -- the question is, can you do it so we can produce them and really help the world, to provide some shelters for these people, like in areas that we just witnessed out there?

COX:
Yes, sir. That's one of the goals at the laboratory, sure.

STEVENS:
Thank you.
Ms. Shea, how do you interface with the concept of, you know, warning to people on the outer islands?

SHEA:
It's a very big challenge. Part of it is a communications challenge, actually, not just the physical technological systems, but also language and communicating in language that is understandable.
But the other is actually building local networks of people who are skilled in understanding in what's coming through as a warning and then can communicate locally, in local languages, and in local context.

STEVENS:
Do you use commercial media?

SHEA:
Absolutely. And, in fact, the role of the media is important, but it's also important to remember that many of the communities, those remote fishing communities, for example, whose structures were completely wiped away, didn't have access to some of the media.
In the United States, we can rely on the media the way the Weather Service has done for years. And I think it's really important that we consider the role of the media in warnings in the United States as well as internationally.
But I also think we have to build that local community network, those community leaders and those trusted information brokers in a community who can help.

STEVENS:
Well, a lot of them didn't have a public media...

SHEA:
That's right.

STEVENS:
... wireless media.

SHEA:
That's right. And...

STEVENS:
My feeling is maybe we should assist them to get wireless media, so it will be there. It would be maintained by the local people. You put up some warning system, someone is going to forget to turn it on.

SHEA:
Yes.
(LAUGHTER)

STEVENS:
Just really providing a continuous service, in terms of some sort of weather service or whatever it might be. I should think on a wireless basis they would have gotten the information much better out there.

SHEA:
I think that's true. And I think there also some fairly low-tech solutions that include hifi radio, HF radio, and satellite downlinks in a wireless way from warning centers that then can be rebroadcast by HF radio that's relatively inexpensive.
The other is, then, combining that wireless link, the information that comes with the wireless link, with low-tech capabilities like warning flags or siren systems.
Those two can be used without having to rely on that infrastructure that you so rightly point out is not available in many of these communities.

STEVENS:
Dr. Hansen, how about using those graduate students out there? I assume they're still watching.
Why don't you review our proposal to have this new Subcommittee of Disaster, Prediction and Prevention and ask them what they think we ought to go into? What should we ask this subcommittee to start out on? What's the most important areas that we could look at to see where there are deficiencies in prediction and prevention? Could you do that for us?

HANSEN:
Yes, I will.

STEVENS:
Thank you.
Senator Inouye?

INOUYE:
As we have demonstrated, it usually requires a disaster of biblical proportions to get all of us acting. For example, it took the tsunami disaster in Southeast Asia to bring about the creation of this subcommittee.
I don't know if you have the expertise to respond, but do you believe that the bill that we are proposing, S. 50, would do what you believe is necessary?

SHEA:
Yes, I think it's a really good start.
I think that if I were looking at S. 50, I might suggest broadening the education components of S. 50. And I also might suggest that we look at ways of broadening that

vulnerability and adaptation research component and, in particular, leveraging ongoing activities.

These same communities that are subject to tsunamis are also, as several people have mentioned today, subject to other coastal threats. There are other coastal warning systems out there. There are climate forecast systems out there in the United States and around the world.

And if we can leverage those, find those partnerships, we can make a significant advance in the receiver end of this problem without an investment of a significant amount of new resources. It's really about bringing those partnerships.

INOUYE:

Would you favor this committee with memos carrying out those proposals?

SHEA:

Absolutely. I'd be happy to, Senator.

INOUYE:

It would be very helpful.

Dr. Cox, this committee has heard that Japan has already developed buildings in place and operational for tsunami purposes. Have you heard about them?

COX:

Yes, sir.

INOUYE:

Are they working?

COX:

To my knowledge, they're working.

But I think that, if I could just continue, I think how many people you could put into the building versus, you know, getting people to higher ground -- I mean, I can't speak for the United States, but I think we have to consider whether or not we have sort of a high concentration of people in a particular area, let's say, at a resort community or something like that. Then I think such a building might make sense. I think other times we have to consider just evacuating everybody to higher ground.

I think we heard earlier that we can't have sort of a one-size- fits-all policy. But I think sometimes it may sense to build tsunami- resistant structures in high-density places like a resort community.

INOUYE:

Dr. Hansen, I think statistics indicate the state of Alaska is more prone than any other state when it comes to earthquakes and tsunamis. Are you satisfied that the warning system we have today is sufficient?

HANSEN:

No, I'm not. I believe that it's insufficient in ways of getting the information out to the local communities. We're in need of...

INOUYE:
How would you improve that?

HANSEN:
Right now we're trying to establish -- or, in fact, we're trying to exercise our established partnership to get out education and outreach programs. We visit communities, we put together videos to help educate populations of Alaska about the tsunami in our state.

In addition, we're trying to work with leveraged monies from the National Hazard Program and the university program to get sirens put out. They've been developed under the national program.

Sirens need to be triggered somehow, so we're working with the NOAA Tsunami Warning Center to put together the infrastructure we'll need to get out to communities where, say, NOAA Weather Wire doesn't work or doesn't work very well and improve that infrastructure to get information out beyond just the local manager, but to the people that are in danger.

INOUYE:
Every since the end of World War II, the state of Hawaii has maintained an air-raid siren system. And it goes off once a month, and some of the tourists go berserk, not knowing whether it's a bombing attack or tsunami, but it serves a little purpose.

Ms. Shea, do you think it works?

SHEA:
Oh, absolutely. I think that, for low-frequency events, like tsunamis, I think we tend to forget, the population tends to forget in the long period of time.

But I think it's useful in the sense that, when we hear it in Hawaii, and we know that what it means is if it's the first Monday of the month, we know its a test, and if it's not the first Monday of the month, then we know there's something to be concerned about. And then we do turn to the television, the radio, call the local agencies, call state civil defense.

So it absolutely does work. Those low-technology but high-impact systems are really quite effective.

INOUYE:
Oftentimes when we venture into something as complex and new, we set up pilot programs. Do you think a pilot program would work in this situation?

SHEA:
I think pilot programs would be, in fact, very useful. And I think, again, look for those opportunities where you have areas at high risk -- Alaska, the Pacific come to mind, in the case of tsunami -- and also those areas where these partnerships of agencies working together already exist.

So I think that we've heard enough testimony today to suggest there are probably a couple of places, at least, where a pilot project could help demonstrate that partnership, demonstrate the different kinds of technology, and demonstrate the value of building this comprehensive risk-management information system.

INOUYE:
See, we have no idea what the cost will be, and a pilot program might be helpful.

SHEA:
Yes.

INOUYE:
Can members of the panel provide us with your ideas of what, if any, should the pilot program look like?

SHEA:
Absolutely.

INOUYE:
I would appreciate it.

COX:
Yes, thank you.

SHEA:
Yes.

INOUYE:
Thank you very much, Mr. Chairman.

STEVENS:
Thank you.
And, Dr. Hansen, I think I'm indebted to you for this, a copy of "Ocean Fury: Tsunamis in Alaska."
Let me read to the senator what this says. It says, "Future tsunamis will hit Alaska. Taking its cue from the survivors of 1964, this program explains how scientists, local officials and emergency responders are working together to reduce the loss of life and property when tsunamis assault Alaska's coast again. With the aid of 3-D computer graphics, scientists describe how different kinds of tsunamis form, how they can travel at jetliner speeds, sometimes striking shorelines with little or no time to escape. More important, this program describes what you should do to improve your chances of surviving the next tsunami."
I hope, Dr. Hansen, you have provided a copy of this to every school in the state.

HANSEN:
The emergency management group is doing that kind of thing. That's exactly right.

STEVENS:

That should be a program that all young people should look at, so they can understand there's something out there to prepare for.

We thank you very much. You demonstrate that this is a issue of substantial concern to where we come from, the two of us. And we appreciate your -- have you got another copy? I'll give that to Senator Inouye.

HANSEN:

I don't with me, but I can get you one.

STEVENS:

One of those graduate student will mail me one.

(LAUGHTER)

We do thank you very much for taking the time to come here. It's very important. This is our first hearing, the two of us, as co- chairmen of this Commerce Committee. We wanted everyone to understand this is going to be one of our number-one targets, to really deal with the prevention and detection of disasters.

Thank you very much.

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